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Constraints on Access: Costs and Benefits (Spontaneous Memory for Relevant Experiences)

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for

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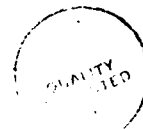
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spontaneous access. The findings indicate that not only similarity in the situational conditions, but -- at least as importantly -- similarity in people's intentions and actions are vital to successful access.



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**Constraints on Access: Costs and Benefits
(Spontaneous Memory for Relevant Experiences)**

Principle Investigators: Jeffery J. Franks and John D. Bransford

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SUMMARY

Spontaneous access and use of previous experiences is a vital and integral part of learning and transfer. The preponderance of learning and memory research over the past few decades has been conducted using directed access paradigms, i.e., design in which the subjects are explicitly instructed to use certain previous experiences in present performance. Recently there has been an increased interest in nondirected access. The designs in these investigations provide subjects with potentially useful experiences. A subsequent task is presented in which performance could benefit from information available in the prior experience. Subjects are not informed about the potential relation between the two events and their spontaneous access to the acquisition experience is assessed by performance on the transfer task.

The present report describes an program of research that has examined the phenomena of spontaneous access using two different nondirected access paradigms. One paradigm involved presenting answers to short insight problems during an acquisition experience and then presenting the insight problems themselves during a problem solving transfer test. The second paradigm involved the presentation of either lists of words (or pictures) or passages for acquisition. The subsequent transfer task involved presenting subjects with a classification test in which the classification scheme required spontaneous access and use of acquisition information.

The overall pattern of findings can be summarized as follows:

At a metacognitive level, the results of spontaneous access studies regularly provide surprises. Situations in which it seems perfectly obvious a priori that people will access and use acquisition experiences turn out to be cases in which people do not in fact attain such access.

If, following some acquisition experience, people are presented with a potential transfer task and they do not attain spontaneous access, later access to the acquisition experience can be disrupted. The processes that people engage in during the first transfer test are re-evoked during a second test and this interferes with retrieval of acquisition information even when people are explicitly directed to try to retrieve the original information. Furthermore, this interference is quite specific to information presented in the first transfer test. It is not a general disruption of access to all aspects of the acquisition event.

Successful spontaneous access and use of prior acquisition experiences is facilitated in situations that instantiate the transfer appropriate processing principle. Problem-oriented processing during acquisition enhances subsequent problem solving in cases where fact-oriented processing of the same acquisition information does not. This facilitation again is quite item specific and not due to induction of a general problem-solving set. Work with the classification paradigm provides further support for the importance transfer appropriate processing in spontaneous access. The findings indicate that not only similarity in the situational "conditions", but at least as important,

similarity in people's intentions and actions are vital to successful access and use of prior acquisition experiences in subsequent transfer situations.

Finally, the research indicates that variables that are important for spontaneous access are not necessarily the same as those that have been found to be effective mediators of directed memory and transfer. Pictures (vs. words) and levels of processing and elaborative encoding manipulations are shown to affect directed access but are found to have no influences on nondirected access to the same information.

In the final section, we discuss some of the implications of this research for the design of effective training procedures.

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CONSTRAINTS ON ACCESS

Students are unexpectedly asked to read a journal article. They are instructed to glean as much information as they can in three minutes. Most of the students begin at the beginning of the article and continue reading word-for-word until they run out of time. When questioned later, all students indicated that they knew about skimming skills. If engaged, these skills presumably could have helped them in this situation, but only a few actually did skim the article (Bereiter, 1984). Everyone had knowledge that would have allowed them to learn more efficiently, but they didn't use it.

This example illustrates a common problem. People can have potentially useful knowledge, but this knowledge is often not accessed and used in situations where it could prove helpful. The present document describes our program of research which was (and is) concerned with understanding the processes involved in spontaneous access to previously acquired knowledge. What conditions and variables lead to the activation of previous experiences (we refer to this as the access issue). Once information is accessed, what determines whether that information is used (we refer to this as the utilization problem)? The reported research examined factors that appear to be important for failure and success in both access or utilization. At the conclusion, we suggest implications for practical training based on our findings.

The Problem of Inert Knowledge.

Earlier in this century, Alfred North Whitehead discussed failures to access pertinent information; he referred to such failures as the inert knowledge problem. He further argued that traditional academic instruction is prone to produce knowledge that is not utilized in real-life situations (Whitehead, 1929). Expressing similar views, Charles Gragg stated that a major goal of education should be to prepare students for action, but that ordinary forms of instruction generally failed in this regard. To meet this goal, he and his colleagues devised the case approach to instruction, an approach specifically designed to overcome the problem of inert knowledge (Gragg, 1940). Many others have pointed to the issue including (Dewey, 1963; Wertheimer, 1959; Polya, 1957; Hanson, 1970).

Cognitive Psychology and Inert Knowledge.

Investigations concerned with spontaneous access to prior knowledge necessarily involve experimental situations in which people are not explicitly prompted to use specific bodies of information. Given the importance of the issue, it is somewhat surprising that non-directed knowledge access has received so little attention from contemporary cognitive psychology. The experimental literature is dominated by results generated through "directed access" paradigms. In this type of experiment, subjects are explicitly told both what they should remember along with the context in which the to-be-recalled information was last encountered. Instances of "directed access" research includes most

list-learning experiments, research on schema/script abstraction, and studies of remembering which might manipulate levels of processing, elaboration, etc, to name just a few examples. In all these cases, subjects first study acquisition materials and are then explicitly informed at test of the relevance of those materials for the test task.

What can be gained through the use of a "non-directed access" paradigm? First, it allows an experimenter to determine if subjects will independently notice a connection between present events and past experiences. Second, if noticing in fact takes place, we can assess whether or not these subjects will spontaneously use this information and perform like directed access subjects in those same experimental conditions.

Recently, a number of researchers have begun to use non-directed access paradigms. Examples include Asch (1969), Weisberg, DiCamillo & Phillips (1978), Gick & Holyoak (1980, 1983), Ross (1984), and Stein et al. (1986). We will not deal in detail with this literature, but we can illustrate the general nature of findings by considering some work conducted in our laboratory Vanderbilt.

Initial research on access using insight problems.

In one of our studies (Perfetto, Bransford & Franks, 1983), we asked college students to solve word puzzles such as the following:

1. Uriah Fuller, the famous Israeli superpsychic, can tell you the score of any baseball game before the game starts. What is his secret?
2. A man living in a small town in the U.S. married twenty different women in the same town. All are still living and he has never divorced one of them. Yet, he has broken no law. Can you explain?

Students in baseline conditions simply read and tried to solve the problems. Performance in these groups was poor, ranging from 18% to 25% correct. Experimental subjects were provided with answers to the problems before trying to solve them. For example, during the acquisition phase that began the experiment, subjects rated the general truthfulness of statements such as:

1. A minister marries several people each week.
2. Before it starts the score of any game is 0 to 0.

Experimental subjects who were then given problems to solve and informed of the relevance of the previous acquisition information (i.e., given "directed access") performed very well. For our purposes, the most important data involve subjects who received the correct answers during acquisition but were not explicitly informed that these answers were relevant for problem solving (i.e., they were presented with a "non-directed access" test). Initially, it seemed obvious to us that these subjects would use the acquisition statements as clues since they were so clearly related to the subsequent problems. Much to our surprise, the problem solving performance of these uninformed subjects was not

significantly better than baseline subjects. Data from one experiment are presented in Table 1.

Table 1

	Trial 1: Problem Solving	Trial 2: Memory	
		Old	New
Informed	73%	81%	69%
Uninformed	18%	43%	63%

The results suggest that uninformed subjects had the relevant knowledge but that this knowledge remained inert. The other researchers mentioned earlier have found similar examples of failures to utilize available and potentially valuable knowledge when subjects are not explicitly informed about its relevance for a particular task.

The Perfetto et al. study also indicates that subjects can suffer interference due to generation of inadequate answers during their initial attempts at problem solving. In the reported experiment, subjects were given the acquisition clues and then presented with only half of the problems on the initial problem solving trial. The uninformed subjects tended to generate incorrect answers.

Subjects were then given a second cued memory trial involving all of the problems. They were presented all 12 problems and were asked to recall the acquisition sentence that was the appropriate answer for each. Under these circumstances the uninformed subjects suffered from interference. They were less likely to recall the acquisition information for those problems that they had previously attempted (i.e., old problems) in comparison to their performance on problems that they were seeing for the first time (i.e., new problems). Informed and uninformed subjects did not differ in their solution rates for the new problems. The inferior performance of uninformed subjects for old items on the second trial can be attributed self-generated inadequate answers from trial 1 interfering with retrieval of the acquisition answers on trial 2. The data for trial 2 are also presented in Table 1.

Access Research Related to Interference.

Based on these initial findings, we conducted a number of studies using the non-directed access, problem-solving paradigm. One line of work pursued the interference effects due to prior problem solving attempts. A second line of research explored possible variables that might facilitate spontaneous access to relevant previous experiences. First consider the work related to interference effects.

Generate vs. Read Processing.

Since the original demonstration by Slamecka & Graf (1978), there has developed a growing body of evidence that self-generated information is remembered better than information that is provided by others and merely read. These findings seemed applicable to the interference effects found in our original experiments. We argued that the interference was due to 1) uninformed subjects generating inadequate answers when attempting to find solve the problems and 2) the previously generated inadequate solutions interfering with retrieval of the acquisition answers in the subsequent informed test. In line with the encoding specificity principle, the inadequate answers that were generated would be encoded with the problems. In later tests the problems would cue retrieval of these inadequate answers and this would interfere with memory for the appropriate acquisition answers.

We reasoned that since subjects generated the inadequate answers, the tendency to subsequently retrieve these answers would be especially strong, which in turn would accentuate any interference effects. To assess these possibilities, we replicated one of our initial experiments and added a yoked-control condition. All subjects received a set of clue sentences during acquisition. In the replication condition, subjects generated (usually inadequate) answers to half of the problems. In the read condition, subjects read these same problems and the (usually inadequate) answers generated by the subjects in the replication condition. Next all subjects were informed about the relation between acquisition and the problems. They were then presented with the both the old problems that had been previously attempted and new problems seen for the first time. They were asked to try to remember the acquisition sentences that corresponded to and solved each of the problems.

We predicted that subjects in the original generate condition would show greater interference than subjects in the read condition. The results were congruent with this expectation (see Table 2). Generate subjects performed more poorly than read subjects on the old items. For the new items, where no interference could develop, the generate and read subjects were equivalent in performance. The findings support the claim that the observed interference effects, are due to previously encoded inadequate answers. However, post-experimental questionnaires and post hoc data analyses suggested an alternate account for the differences in performance of the generate vs. read subjects.

Table 2

Trial 1	Trial 2: Memory	
	Old	New
Generate answers	41%	72%
Read answers	56%	70%

More "read" than "generate" subjects reported that they spontaneously caught on to the relation between acquisition sentences and the problems during the initial uninformed presentation of the problems. We suggested that this difference was attributable to differential processing loads entailed by generate vs. read processes. Note, that if subjects (in either generate or read conditions) become aware of the relation during this initial stage, it is likely that for subsequent problems they will retrieve the appropriate acquisition answers and thus obviate subsequent interference for those items. If more read subjects caught on, then read subjects should show less interference for old problems on trial 2 (as was found.)

Of course, the prior generation vs. reading of inadequate answers could further enhance any interference effects that were present and thus accentuate the difference between generate and read performance. We conducted an extensive series of followup experiments attempting to more precisely differentiate the effects of differential spontaneous noticing of the relation from effects attributable to generation-accentuated interference. Unfortunately, the results of this work were equivocal. As a result we have evidence for differential noticing but not for generation effects. A more detailed account of this work appears in Perfetto, Yearwood, Franks, & Bransford (1987).

We can note two additional points related to this generate vs. read research. First, on the basis of more recent work another account of the findings seems likely. It may be that the increased noticing in the read condition can be attributed to transfer appropriate processing effects (Morris, Bransford, & Franks, 1977; Bransford, Franks, Morris, & Stein, 1979). Our work (described below) on problem-oriented acquisition and other lines of work using a classification paradigm suggest similarity in the processing requirements between acquisition and test can be an important factor in promoting spontaneous access. Note that the acquisition in this case involved passive, comprehension encoding of the acquisition sentences. The read condition also invited passive comprehension encoding while the generate condition asked for active problem solving. The greater similarity between acquisition and read processing modes may be the basis for the enhanced access. Further work can differentiate between the load and transfer appropriate processing interpretations.

Finally, as a foreshadow of later sections of this report, we can note that we became quite frustrated with these attempts to use the insight problem paradigm to ask more detailed, analytic questions. The paradigm is fine for demonstrating strong main effects, but it basically lacks precision. These equivocal followups were a basic impetus for our search for an alternative, more precise paradigm, that eventually led to us to the classification paradigm which will be described in later sections.

Intentional Forgetting.

If generation of inadequate answers interferes with later access of appropriate information, can something be done to alleviate this interference? Research concerned with "intentional forgetting" suggests that interference may be overcome if people attempt to intentionally forget specific sets of information (Bjork, 1972). While there is not a clear consensus concerning the mechanisms that underlie such intentional forgetting effects, the effects themselves seem robust. If people can gain conscious control of such interference through intentional forgetting this could have important practical implications.

We conducted a series of experiments, each a variation on the theme of having subjects intentionally forget the information they generated in attempting to answer the insight problems. These attempts were not successful in reducing the interference effects. Unlike reported work on intentional forgetting, subjects in our experiments did not seem to be able control the effects of their self-generated inadequate answers. Our lack of replication of intentional forgetting effects is not too surprising. Our procedures and materials were quite different from those typically used in intentional forgetting research. In any case our results suggest that in practical training situations, one should be concerned if the situation allows people to generate inappropriate information--it may be difficult to eliminate potential interference effects later.

Attempts to Facilitate Access.

The lack of spontaneous access in this research remained the most surprising and important result. We conducted a number of studies which were essentially aimed at facilitating access.

Copy Cues.

Probably the most obvious way to try to facilitate spontaneous access is to increase the similarity between the acquisition and transfer test materials. Of course, in designing our first experiment in this area we intentionally chose our acquisition and test items to be obviously similar--we wanted to guarantee access in this first attempt and then go on to vary factors attempting to reduce access. Given that our original guesses concerning similarity were wrong, we decided to increase the similarity between acquisition and test items even more.

We increased this similarity with "copy cues". We re-designed the materials so that some of the acquisition sentences and the insight

problem test items contained identically worded clauses and phrases. All subjects received the acquisition items, while degree of similarity was manipulated in the problem solving test. In one test condition, subjects first received several test items that contained copy cues and then additional items that did not contain copy cues. In a second condition subjects never received copy cue items (this condition was comparable to those in our original work.)

The results are presented in Table 3. For the initial test items, the presence of copy cues did indeed enhance spontaneous access to the acquisition items corresponding to the problems containing copy cues. Greater similarity seems to lead to greater access. But that is not the whole story. Look at performance on later test items. Subjects in the no copy cue condition outperformed those in the copy cue condition.

Table 3

	Initial Test Items	Later Test Items
Copy Cue	42.5%	33.3%
No Copy cue	33.3%	54.0%

The later items were identical for both groups and did not contain copy cues. It appears that the early presence of copy cues led subjects to set relatively high thresholds for the similarity needed to induce access and use of the acquisition clues. That is, these subjects were looking for copy cues and when they didn't find them, acquisition information was not seen as relevant. It seems surprising that these subjects did use acquisition information to solve almost half of the initial problems but the idea of using acquisition didn't generalize to the later items. This suggests that spontaneous access can be governed by very specific relations between prior experiences and later transfer situations. We will return this point concerning specificity when we describe the findings from a classification paradigm below.

To order to obviate possible inappropriate inferences, we should note that the items in the test list in this experiment were ordered from most to least difficult. The difference in performance on the initial vs. later non-copy cue items was due to this ordering. It is interesting to note that the early presence of copy cues seems to actually suppress performance. On later relatively easy items the copy cue subjects performed at the same level as non-copy cue subjects did on initial more difficult items.

Prior Problem Solving.

In another line of work, we attempted to enhance spontaneous access by exposing Ss to the insight problems before presenting them with the acquisition sentence answers. Our thinking involved variations on the Zeigarnik effect (cf. Woodworth & Schlosberg, 1954). Roughly, with pre-exposure subjects in Zeigarnik effect experiments would try to solve the problems--and usually fail. But the failure would leave a lack of closure in their understanding and they would be sensitized to subsequent information that could complete their understanding.

In our experiment, one group of subjects first attempted to solve problems while a second group did nothing. Next both groups were presented with sentences that were answers to problems. All subjects were uninformed--they were not told about the relation between problems and answers. Then all subjects attempted to solve the original problems again.

The two groups demonstrated poor and equivalent performance in the later problem solving task. In terms of problem solving performance,

pre-exposure to the problems did not help. Interestingly, questionnaire data suggested that pre-exposure to the problems may have increased the number of subjects who spontaneously noticed the relationship between the acquisition answers and problems. This seemingly should have enhanced performance in the pre-exposure group, contrary to the data.

It appears that what the data actually shows is a trade-off in effects due to pre-exposure based interference effects countering potential facilitations due to increased noticing. As previously discussed, unsuccessful prior problem solving can lead to subsequent interference in access. The pre-exposure group engaged in such unsuccessful processing while the other group did not. Interference effects in former groups later problem solving seem to have countered any benefits attributable to enhanced noticing in this group.

Fact vs. Problem Oriented Acquisition.

The design of this study evolved from the prior problem solving work as well as considerations from the perspective of transfer appropriate processing (Morris, Bransford, & Franks, 1977; Bransford, Franks, Morris, & Stein, 1979). The presence of interference effects due to prior solution attempts led us to seek a method that would provide a prior problem solving experience without having subjects generate inadequate answers. The transfer appropriate processing perspective suggests that transfer (and in the present case spontaneous access) will be most effective if people process information in the same manner in both acquisition and later transfer situations. In the present case this suggests that an acquisition experience that engaged problem solving processes might enhance spontaneous access during these problem solving tests.

To meet these conditions, we altered the form of the acquisition sentences. Consider the following two examples of the acquisition sentences used in our earlier studies.

A minister marries several people each week.
A person walking on frozen water will not fall through.

Notice that the information is all in the form of "factual" or "declarative" statements. The following two examples illustrate how we changed the form of these sentences to create "problem-oriented" acquisition items.

It is common to marry several people every week; if you are a minister.
A person walking on water will not fall through; if it is frozen.

The sentences are restructured so that subjects first experience the existence of a problem (i.e., the information prior to the semicolons) and then experience a solution. We also varied the length of the pause at the semicolon.

We compared this problem-oriented acquisition condition with our usual fact-oriented acquisition condition. We expected the problem oriented group to show greater spontaneous access and thus higher problem solving rates than the fact-oriented group. The results in Table 4 matched our expectations. On trial 1 problem solving both problem-oriented conditions were better than the fact-oriented condition. The length of the pause did not make a difference--just experiencing the problem and then having it resolved is enough to facilitate subsequent spontaneous access and use of the acquisition information.

Table 4

	Trial 1: Problem Solving	Trial 2: Memory	
		Old	New
Fact-oriented	36%	48%	62%
Problem-oriented No Pause	31%	65%	72%
Problem-oriented Pause	36%	72%	76%

Table 4 also presents data for an informed second trial. All subjects are told about the relation between acquisition and problem solving and are asked to retrieve the sentence that appropriately answers each problem. In replication of previous studies, interference is found for the regular fact-oriented acquisition condition. Subjects' retrieval of the sentences associated with old problems (i.e., problems attempted during trial 1) was significantly less than that for new problems. Little interference was found in the problem-oriented conditions, reflecting the fact that these subjects tended to spontaneously access the correct answers during trial 1 and thus not generate inadequate (interfering) solutions.

The three groups did not differ significantly in their performance on new problems on trial 2. This result supports the conclusions of the second experiment (described below), that the observed differences in performance were not due to differential memory strength of items induced at acquisition.

In a second experiment we sought to analyze in more detail the processes that were responsible for the enhanced performance in the problem-oriented conditions. We examined two possibilities: a "global set hypothesis" and a "item specific" hypothesis. The global set hypothesis is that, during acquisition, problem-oriented items elicit a general problem solving style of cognitive processing. This style is re-evoked by the problems during test, and this general similarity in processing mediates spontaneous access. The item specific hypothesis is that the problem-

oriented acquisition results in process encodings that are unique to individual items and that later spontaneous access involves the specific relations between particular problems and their corresponding acquisition sentences.

In overview, the design involved within-subject manipulations of the problem- vs. fact-oriented acquisition factor. On a first problem solving trial subjects were tested with either 1) problems corresponding to problem-oriented acquisition sentences or 2) problems corresponding to fact-oriented sentences. If a global problem solving set is responsible for enhanced spontaneous access, subjects should show facilitated performance on both types of test problems. If the item specific hypothesis is correct then only the first type of problem should show enhanced performance. The results supported the item specific hypothesis and not the global set hypothesis.

Results of a second test trial involving informed cued recall of acquisition sentences, demonstrated that these performance differences were not attributable to differential memory strength due to the differing acquisition conditions.

This work with problem- vs. fact-oriented materials is described in more detail in Adams, Kasserman, Yearwood, Perfetto, Bransford, & Franks (1988). Very similar work has been reported by Lockhart, Lamon, & Gick (1988).

Investigations related to problem- vs. fact-oriented acquisition experiences have continued. A recent experiment provides additional support for the item specific nature of the performance enhancements due to problem-oriented acquisition. Following a mixed problem- vs. fact-oriented acquisition, subjects were presented with a mixed list of problems related to both types of acquisition statements. Performance was facilitated for problems related to problem-oriented sentences but not for those related to fact-oriented sentences.

These findings suggest that even in the case where problem-oriented acquisition helps people solve some of the test problems and by doing so increases their awareness of possible relations between acquisition and test, their enhanced performance and awareness doesn't generalize to the fact-related problems. This result is reminiscent of the previously described copy cue result. People seem to be quite specific and conservative in their access and use of previous experiences.

Overall, results suggest that spontaneous access and use of previous acquisition experiences can occur without a general "aha", insight by subjects into the relation between acquisition and test. That is, subjects can show transfer without seeming to "catch on" to the nature of the experiment. If they did "catch on" we would expect to find that they adapt a general strategy of using acquisition information to try to solve all test items following this insight. The data don't reflect such behavior. The results of work using a classification procedure to assess access (described later in this report) suggest similar stages in access,

i.e., levels of spontaneous access that vary in the degree of people's awareness and use of previous experiences.

Problem Oriented Acquisition in more Complex Domains.

We have also extended our investigations of problem-oriented processing to situations that involve less contrived, more semantically rich, acquisition and transfer experiences. A study by Sherwood, Kinzer, Bransford, & Franks (1986) provides one illustration of the effects of various acquisition activities on subsequent access. In that study we investigated the effects of learning information in the context of a general problem solving situation such as Indiana Jones' need to plan and bring equipment in order to survive in the South American jungle. The trip to the jungle represents what we call a "macro-context". According to our definition, macro-contexts involve a series of specific actions and consequences that revolve around an overall goal. The overall goal requires students to consider a number of subgoals. We assume that this linking of subgoals helps students integrate knowledge that might otherwise be learned in piecemeal fashion.

The materials for the experiment involved a number of short passages about topics that might be encountered in middle or high school science classes, examples included the possibility of solar-powered airplanes and the use of water as a standard for density. College students in one condition simply read about each of the topics with the intent to remember the information. A second condition read the same information in the context of problems that might be encountered during Indiana Jones' trip to the jungle. For example, the possibility of solar-powered aircraft was discussed in the context of finding transportation in areas where fuel was scarce. This type of presentation was intended to help students understand the kinds of problems that science information could help solve.

Following acquisition, everyone received one of two types of tests. Half of the people in each condition were simply asked to recall the topics of the passages they had just read. As expected, students who learned in the South American jungle context remembered more topics than those in the no-context group. The remaining students in each group received a test designed to assess whether they would spontaneously access and use the information to solve new problems. They were asked to imagine that they were planning a journey to the American desert Southwest to search for Pueblo relics. They were to suggest areas of information that would be important for planning and survival.

The results in this latter condition indicated large differences in spontaneous use of the acquisition information. Students in the no-context condition almost never mentioned specific information from acquisition--their answers tended to be very general. In contrast, people who received the macro-context tended to make good use of the acquisition information and were quite specific and precise in this usage. Overall, these students who received information in the problem solving

context were much more likely to remember what they read and to spontaneously use this information for creating new plans. Similar effects on recall of science information were found with 7th and 8th grade students.

Spontaneous Memory and Classification

While research on spontaneous access has been proliferating in recent years, most of the work to date, including our own as reported above, has been constrained by methodological factors. Most of the work fits within the rubric of problem solving studies and has been carried out with rather contrived materials. Dunker's radiation problem, or the simple insight problems we have used, are typical examples of such materials, and problem solution rates are the basic measure of access. These materials place constraints on possible manipulations of variables and possible limit the generality of conclusions that are drawn. The measures do not have the precision and sensitivity one would like for detecting the effects of potentially important variables. In the final phases of the present research project, we developed an alternative methodology that can be used with virtually any kind of materials and that provides a sensitive measure of the spontaneous access that may occur.

The experimental paradigm is quite simple. People are first presented with an acquisition experience; for example, they may be read a list of words or they may read a passage. Later they are presented with a classification task. Thus, they may be presented a list of words, told that some of the words are "a" words and the rest are "b" words, and that their task is to guess which are "a's" and which "b's". The Ss guess for each word and then are given feedback about the appropriate classification for that word. The key is that the task is designed so that if Ss spontaneously access and use their prior acquisition experience the classification task should be easy. For example, suppose that after previous presentation of a list of words, during classification the "a" words are old words from that previous list and the "b" words are all new words. To correctly classify the words, Ss must merely access the previous experience of the word list and use the accessed information to appropriately classify the words--in essence, the classification task is an implicit recognition test in this case.

Note three characteristics of this paradigm. First, virtually any type of materials can be used for the acquisition and test--words, passages, pictures, scenes. Second, the "classification rule" can be virtually any property or relation that is contained in the acquisition event--i.e., the above old/new rule is just one possibility. Third, the series of test items provide an ongoing measure of whether Ss have accessed the acquisition event, which makes this measure a potentially more sensitive measure than the all-or-none index provided by problem solutions.

We have conducted a number of experiments using this paradigm, and the results not only support the utility of this paradigm for studying spontaneous access, but have provided us with a number of surprises. Over a series of studies, we've used both word lists and passages as acquisition materials and both the old/new (recognition) relation and relative frequency of occurrence of items during acquisition as the classification rule.

Word (or Picture) Lists and Old/New Classification.

We have recently completed a series of six experiments using word or picture lists as the acquisition events and the old/new recognition rule for the classification task. The basic form of the experiments involved 1) presentation of a list of acquisition items, 2) presentation of an uninformed classification task, 3) administration of a questionnaire, and 4) sometimes, presentation of a second informed classification task. The primary variables that were manipulated across the experiments involved the nature of the tasks Ss were asked to perform during acquisition and classification and the types of acquisition and classification materials.

For both the initial and final classification tasks Ss were told that they would be presented with words one at a time, that some of the words were "a" words and some of the words were "b" words and that their task was to try to figure out which were "a's" and which were "b's". After each word, Ss guessed which classification was appropriate and they were then provided feedback about the correct classification. In fact, the "a" words were new words and the "b" words were old, that is, words previously presented during acquisition. For the first classification task, experimental Ss were uninformed, i.e., they were not told about the relationship between acquisition and classification. When experimental Ss received the second classification task, they were informed, i.e., they were told about the relationship between the a/b classification and the new/old relation. Different old and new words were used in the two classification tasks.

The questionnaire following the first classification task assessed Ss awareness of the relation between acquisition and test. In essence, it discriminated two levels of awareness: 1) whether Ss noticed that some of the classification words had occurred during acquisition (i.e. Noticers) and if they did notice, did they use this information to help them during classification (i.e., Users).

Experiment 1a. The results of exp. 1 were a surprise; these results led us into this whole set of experiments. In this case the procedures were bare-bones simple. For acquisition Ss were simply told to listen to the list of words. During classification they were simply told to try to discover the classification scheme. At the time it seemed absolutely obvious to us that everyone would notice and use the relationship between the acquisition and classification materials. After all, the latter was simply a recognition test, albeit an implicit one, and we expected high accuracy in classifications like one would find with recognition. We actually ran this condition so that we could clearly demonstrate the

viability of this paradigm. We then planned to use designs with more subtle schemes for relating acquisition and classification. In contrast to expectations, our Subjects performed at chance levels in the classification task--no one caught on to and used the old/new recognition relation. On the other hand, all Ss reported noticing that some of the classification words had occurred previously during acquisition, so they seemed to have attained some level of spontaneous access. (This possibility of difference in levels of awareness and of spontaneous access is one that we will return to a number of times in this section.)

Experiment 2a. Both this failure of Ss to spontaneously access and use acquisition, plus the surprising failure of our prior intuitions, reminded us of the earlier access failures and our surprise using the insight problems. As reported above, considerations of transfer appropriate processing (especially couched in terms of productions) lead us to the problem oriented acquisition materials that did result in successful spontaneous access. We applied similar reasoning to the classification paradigm, i.e., have Ss perform the same "actions" in response to the same "conditions" during both acquisition and classification and this similarity in productions should promote spontaneous access. Our manipulation of "same actions" was simple and literal. During acquisition we asked Ss to write down each word as it was presented and during classification we asked Ss to write down words that they thought were "b's" (b=old word) and only write "a" for a words. The results were the same as the first experiment; Ss performed at chance. They reported noticing that some of the classification items had occurred during acquisition but reported that they did not use this information during classification.

Experiment 3a. Our next reaction to the surprising results of exp. 1a, was that maybe, for some reason, the "oldness" of the words during classification was just not salient enough. For exp. 3a we decided to make the old information more salient. Since pictures are generally more easily recognized than words, we used pictures instead of words for the acquisition and test materials. The results were the same as with words--Ss showed chance levels of performance on the first uninformed classification task. Furthermore, we simultaneously demonstrated the enhanced recognition salience for pictures over words, at least for informed recognition performance. On the second informed classification task, performance with pictures was superior to that for words. Once again, although no Ss reported using the old/new relation during classification, nearly all Ss reported noticing that some of the classification pictures (or words) had previously occurred in acquisition.

Experiment 4a. We next tried a combination of transfer appropriate processing and levels of processing manipulations. Greater depth of processing has been shown to have powerful effects on informed memory performance. We reasoned that maybe the acquisition phases in the first three experiments did not elicit adequate semantic, elaborative processing and that this was the source of the access failures. In exp. 4a some Ss make pleasant/unpleasant ratings for acquisition words and other Ss made such ratings in terms of an elaborate encoding scenario. Furthermore, to

meet transfer appropriate processing constraints, during uninformed classification, Ss were asked to make the same type of ratings that they made during acquisition.

Once again the results were the same. Ss performed at chance on the uninformed classification task despite the enhanced elaboration and depth of processing and the similarity in "condition/action" pairings between acquisition and classification. The second informed classification task verified the efficacy of the levels of processing manipulations for informed memory--classification was better for these conditions than for Ss who were merely asked to listen to the acquisition list. Once again nearly all Ss reported noticing that some of the items in the classification test had occurred previously but did not use this information to help them classify items.

Experiment 5a. The design of exp. 5a derived from the insight that "old" words are not "old" during acquisition--they only become "old" at time of test. We realized that we were asking Ss to make classifications based on recognizing the differentiation between the oldness vs. newness of items. The condition (old item) action (recognition) pairings that were the basis for classification could not be learned during acquisition and thus was not directly available for spontaneous access and use. The answer: give Ss appropriate recognition experiences during acquisition.

During acquisition, some of the words were repeated three times with spacing. We reasoned that repeated words would elicit recognitions during acquisition and thus the old word-recognition pairing would later be available to resolve the a/b classification. To further manipulate the transfer appropriateness of processing, some Ss wrote down the words during acquisition while others did not and this was crossed with either writing down words during classification or not.

With some minor complications the results were clear. About half of the Ss spontaneously accessed and used their acquisition experience during classification and showed high accuracy in classification performance. Furthermore, these Ss reported both that they noticed that some of the words had occurred previously and that they used this information to make their classifications. An important aspect of the results is that this access occurred only with high degrees of specificity in condition-action pairings between acquisition and classification.

The specificity of the condition-action pairings is illustrated by the fact that merely repeating items during acquisition (thus allowing recognition) is not enough. If Ss wrote (repeating) words during acquisition, spontaneous access occurred only when they also had to write words during classification, not when they didn't write down the words during classification. Ss who didn't write (repeating) words during acquisition and didn't write words during classification also showed spontaneous access. Successful access appears to be correlated with learning a very specific production system during acquisition that can be accessed and is an appropriate support for later performance. In this case the Ss learn a specific "condition (repeating word)"--"encoding action

(writing or nothing)"-"judgmental action (recognition)" system that can be accessed and used during classification.

Experiment 6a. For the final experiment in this series we assessed whether the conclusions drawn from exp. 5a generalized to conditions involving deeper and more elaborate encoding processes. The design was very similar to that of exp. 5a except that instead of writing words down (or not) during acquisition and/or classification, Ss were asked to make pleasant/unpleasant ratings of the (repeating) words.

The results were very similar to those of exp. 5a and supported the same conclusions. Spontaneous access and use of acquisition information did occur for about half the Ss but only in those conditions in which the "condition (repeating word)"-"encoding action (pleasantness ratings or not)"-"judgmental action (recognition)" was the same during acquisition and classification.

The conclusion from this series of experiments is straightforward: spontaneous access and use of prior experiences (i.e. transfer), can require very specific similarities in both conditions and actions between prior acquisition experiences and subsequent transfer situations.

We have begun four additional lines of experimentation using this classification paradigm. Each of these will require further work but the initial findings will be reported here.

Categorized Word Lists and Old/New Classification.

This study represents an initial use of the classification paradigm to investigate spontaneous access for more structured acquisition materials. For this first examination, we used a categorically organized word list. Categorical structure can have large effects on informed memory performance; the question was, would such effects also influence uninformed spontaneous access?

The basic procedures were the same as in the above experiments. In this case the acquisition list consisted of 60 words, 5 from each of 12 categories with each set of 5 items presented as a block. Ss were merely asked to listen to the list of items. The classification was based on the old/new recognition rule with old items as "1's" and new items as "2's". (1's and 2's replace a's and b's as classification labels in this experiment.) Different classification conditions were formed by crossing two factors.

One factor varied the similarity of items between acquisition and test: the "b" (old) items were either actual items that had been presented during acquisition or were new members of old categories, i.e., words that were not presented during acquisition but which were members of categories that were presented during acquisition. "a"(new) items were items that were neither presented during acquisition nor members of categories that occurred during acquisition. Essentially, this factor can be seen as a manipulation of the surface vs. deep structure similarity between acquisition and classification.

The second factor varied the similarity of the list structure between acquisition and classification. The "b" ("old") items were either presented in a random order or were pseudo-blocked i.e., all the test items from a given category occurred together except for some intervening "a" (new) items.

We expected that both surface similarity (i.e., identical words) and similarity in blocking to enhance spontaneous access. The results were straightforward. All acquisition/classification combinations resulted in about half of the Ss spontaneously accessing and using acquisition to help them in classifying items. The surface vs deep similarity and the variation in list structure similarity had no effects on spontaneous access.

It is noteworthy that, in comparison to the previously described work, the categorical structure of acquisition and test did successively promote spontaneous access and use. Note also that in this case words were presented only once during acquisition. In the previously described cases transfer only occurred for items repeated during acquisition. It may be that both acquisition and test elicited categorical judgments of the words and this action being common to both acquisition and classification promoted access and transfer. But the above experiments also had such common actions and yet spontaneous access occurred only with repeated items. Is this case an exception? It might not be. Note that while actually presented items were not repeated during acquisition, categories were. For example, if Ss labelled items with their categories during acquisition then the generated category labels would be repeats and thus potentially bases for access if Ss generated the same labels during classification. Followup studies will examine such possibilities.

Blocking of Old Items during Classification.

In this paradigm, the classification task is essentially an hypothesis testing situation for Ss. They try out rules of various types e.g., semantic, structural etc., hoping to match the a/b classification pattern. The Ss indeed report using many different strategies of these kinds. The old/new classification scheme based on prior acquisition is just one of many possible rules and it must compete with the other possibilities. It seemed that relatively higher proportions of old to new items during test would enhance the likelihood of Ss sampling and "verifying" the old/new rule as being applicable.

As our first attempt to manipulate relative occurrence of old to new items in classification, we chose to try a rather extreme manipulation. Following an acquisition procedure like that of exp. 1 reported above, we presented Ss with a test list that started off with 10 old items in a row before the appearance of the first new item. All of the old items had occurred only once during acquisition. This procedure did in fact promote spontaneous access and use of the acquisition information--about half of the Ss caught on to the old/new rule and showed highly accurate performance rates. It seems that the blocking of old items allowed Ss to zero in on the old/new relation as the classification rule.

We think that this initial blocking is really just a special case of relatively high "density" of old items to new items. Followup experiments will vary the relative proportion of old to new items in randomized lists. We expect access and usage will be a positive function of this proportion. Note that this result (with the possible exception of the category structure findings) is the only case we have so far found in which access is attained for words that are not repeated during acquisition.

Differential Frequencies and Classification.

In another line of work we based the classification scheme on the relative frequency of occurrence of words during acquisition rather than on the old/new relation. Researchers like Hasher and Zachs (1984) have argued that relative frequencies of occurrence are automatically encoded. If they are automatically encoded, are they also automatically accessed in related subsequent experiences? Two experiments have been conducted thus far in this line of inquiry.

Experiment 1b. To begin our investigation we used a simple variation of exp. 1a as reported in the old/new package above. We presented Ss with an acquisition word list in which some words occurred 3 times and others only once. For classification, we presented only old words, some of which had previously occurred 3 times (these were labelled a's) and some that had occurred only 1 time (these were labelled b's).

The results were quite simple. Ss performed at chance. No one accessed and use the relative frequencies of occurrence during acquisition to perform the classification task. Ss did report noticing that the classification list contained words previously presented during acquisition and that they had noticed that words differed in their relative frequencies during acquisition but they reported that they didn't use this information during classification.

Experiment 2b. By analogy to the above reported work, we decided that once again we might be missing how extremely specific the relation between acquisition and classification must be for spontaneous access to occur. In exp. 1b, even though the words had different frequencies of occurrence during acquisition, both types of words only occurred once during the classification task. What if part of what the Ss learned during acquisition was a production system consisting of a pair of productions something like 1) condition=word x--action=note occurrence, and 2) condition=repeating word--action=note repetition? Compare this to the conditions available during classification in exp. 1b. All conditions are of the form "condition=word x". No item repeats. Maybe classification wasn't accessing the above production system because part of the conditions were not being met.

To assess this possibility, we left acquisition unchanged but modified the classification task. Words that occurred once in acquisition also occurred once in classification; words that were repeated in acquisition, were repeated during classification. Spontaneous access and use of

relative acquisition frequencies was found in this modified condition. Again, about half of the Ss caught on and used this rule. Interestingly, and as would be expected given the results of exp. 1b, there was no evidence of spontaneous access prior to the occurrence of the first repeated word during classification. Before this point all words only occurred once and access does not occur under these conditions.

In the experience of events it seems likely that the relative frequencies of different aspects or components of events are indicative of the relative importance of those features. It also seems reasonable that a feature's relative importance with respect to some prior experience, should be related to the probability that reoccurrence of that feature would promote access to the prior event. In our followup work we will further develop this line of thinking and the role of relative frequencies of occurrence in spontaneous access.

Passages and Old/New Classification.

We have conducted two experiments with the classification paradigm in which we used passages as acquisition materials, instead of word lists.

Experiment 1c. Our first experiment extending the classification paradigm to passages was simple and straightforward. For acquisition Ss first read a fairly extensive descriptive passage (about 1500 words). The passage was presented 1 sentence at a time under Ss' control and Ss were instructed to press a key to advance to the next sentence as soon as they comprehended each sentence. The classification items consisted of old propositions (i.e., ones that occurred in the passage) which were labelled as "1's" and new propositions (i.e., ones that did not occur in the passage) which were labelled as "2's". Following classification, Ss were given a questionnaire to assess whether they noticed that some of the items had occurred during acquisition and whether they used this information in making their classifications.

About half of the Ss did in fact spontaneously access and use the acquisition passage during classification. What was especially interesting about the results of this experiment is that the questionnaire could be used to divide Ss into 3 subgroups. As just mentioned, about 1/2 of the Ss reported that they both noticed that some items had occurred during acquisition and used this information in making their classifications. These Ss (the notice and users) were very accurate in their classifications of both old and new items. A second subgroup (about 1/4 of the Ss) reported that they didn't even notice that any of the classification items had occurred in the passage (and of course they didn't use this information in classification.) These Ss (the non-noticers) performed at chance in the classification task.

The third subgroup (about 1/4 of the Ss) provided new insights into the processes involved in spontaneous access. These Ss reported that they noticed that some items had occurred previously, but that they did not use this information in making their classifications. The classification performance of these Ss (the notice but non-users) remained

at chance during the first stages of the classification task, but by the end of classification they were showing better than chance performance and most importantly they were significantly more accurate in classifying old items than new items. This is in contrast to the first subgroup (the notice and users) who were equally accurate in classifying old and new items. While greater than chance the classification performance of the notice but non-users was significantly less accurate than the notice and users.

These findings indicate that spontaneous access is at least a two-level process and that the different levels can be differentiated using the classification paradigm. The non-noticers seem to have had no access to the acquisition passage. In contrast, the notice and users not only accessed the passage but consciously, intentionally used the information from the passage to make their classifications--they were consciously aware of and made use of the old/new distinction. The notice but non-users accessed acquisition as indicated by their reports and better than chance performance in classification. But both their reports and their classification performance suggests that their level of access did not reach a conscious, intentional state.

We suggest that the latter Ss were gradually learning the correlation between "oldness", or maybe better, "familiarity" of passage related items and their classification as "a's", but that this learning was occurring in a relatively automatic, preconscious manner, i.e., as if the connection was being slowly conditioned. The asymmetry in performance on olds vs. news is especially important. The "old" items have some special features due to their previous occurrence, i.e., familiarity, perceptual fluency... This property can gradually be associated with the appropriate classification. But we suggest that for these Ss, the old items are not really "old" per se.

We suggest that old vs. new is a dimension of cognition is a conscious, intentional distinction--new items are judged as not-old. Other support for this idea comes from informal interviews with Ss. They seem to say that during classification prior to catching on to the rule, they notice that some items had occurred during acquisition but they do not notice that some of the items had not occurred during acquisition i.e., they seem to have some kind of awareness related to "oldness" but to have no awareness of "newness".

It seems likely that this preconscious access phase precedes full conscious, intentional access, but so far we don't have strong evidence to support this conclusion--it may just be an alternate independent access process. We have examined the data of the notice and users and early in classification they seem to show an asymmetry in accuracy in classifying olds and news (supporting the stage conception). However, we have also looked at performance of Ss in the previously described word list studies from this perspective and found no evidence for a pre-conscious access stage. In those experiments, Ss who reported noticing that some items had occurred previously but didn't use this information in classification showed chance performance on both olds and news. Those Ss who

reported using the old/new distinction showed no early asymmetry in old vs. new performance. We are pursuing these ideas of different access processes and a possible stage conception of access with further experiments.

Experiment 2c. In a second experiment using passages as acquisition materials, we attempted to assess whether the structural constraints available in connected discourse would influence latter spontaneous access to the passage information. During acquisition we presented Ss with 4 short, unrelated descriptive passages. The classification materials consisted of old words from the passages vs. new words. The structural similarity between acquisition and classification was manipulated by the sequencing of old items during classification.

Four levels of structural similarity were implemented: 1) old items from all four passages were presented randomly intermixed with new items, 2) old items were blocked by passage (i.e., all the old items from passage x were presented intermixed with new items and then all the old items from passage y etc.) but the items from a given passage were randomized, 3) a high proportion of the cases in which old items followed other old items were constructed so that both old items occurred in the same sentence in acquisition, and 4) the successive old items during classification in essence appeared in the same order as they had in acquisition, i.e., old items were not only blocked by passage but in most cases, successive old items came from the same or successive acquisition sentences and appeared in the same order as they had during acquisition.

Designing the lists with these constraints was complex but the results were simple. In this experiment, essentially no one spontaneously accessed and used the acquisition passages during classification. Ss performed at chance. Furthermore, unlike in the word list acquisition studies, Ss in this experiment didn't even notice that some of the words had previously been presented during acquisition. That is, Ss showed no evidence of access at any level. Needless to say we were once again quite surprised, especially given the fourth condition above with its high structural similarity to acquisition.

At this point of course, we can only make tentative conclusions, but we think that the lack of access in this case represents another case of the high degree of specificity that is necessary for promoting spontaneous access. In previous work (Franks, Plybon, and Auble, 1982; Auble & Franks, 1983) we suggested that words in isolation are not psychologically the same units as the same words in connected discourse. To the extent that this is the case the similarity between the classification task and the acquisition passages might have been much less than it seemed. Furthermore, from a transfer appropriate processing perspective, the types of processes elicited by acquisition passages and classification lists were likely quite discrepant. The passage engaged text comprehension processes; the word lists likely engaged more analytic, feature generation processes. This lack of congruence in processes could have contributed to the access failure. Followup work can examine these possibilities.

Demonstration of Highly Successful Access.

As a final case using the classification paradigm, consider a case in which virtually all subjects spontaneously accessed and used a prior acquisition experience during classification. This case is more a demonstration than an experiment, but it is interesting because access occurs with little similarity in stimulus events and over a long interval of time.

This demonstration involved performing a second experiment with subjects who had previously participated in a classification study. The previous study was the previously described experiment that used categorized word lists during acquisition and classification. Approximately 6 weeks later subjects from the categorized list experiment were recruited for participation in another experiment. No mention was made of the previous experiment. This second experiment was designed to differ from first in many obvious respects. It was conducted by a different experimenter in a different room (although in the same building.) The acquisition and classification items were pictures instead of words and a's and b's were used as classification labels instead of 1's and 2's. Also, classification items had occurred only once during acquisition. What remained the same was the fact that it was a psychology experiment, there was an initial exposure to some information, and there was a subsequent classification task.

Despite all the differences and the time interval between experiments, over 90% of the subjects accessed and used the acquisition pictures to perform the classification task. The global analogy between the two experiments clearly promoted access and use of the previous experimental experience. This result may seem obvious, but we expected other obvious results that did not occur. It was a nice demonstration that spontaneous access is enhanced when people are asked to do what they have done before, even if they physical situation and the materials to be acted upon differ from the previous experience.

While the outcome might seem obvious to us and the reader, the question remains--what made the relation obvious to the subjects? Was it merely the fact that they were both psychology experiments--e.g. would they show similar facilitation in spontaneous access if the second experiment used the insight problem paradigm? Was it the use of the classification task in both cases--would they show similar facilitation if the second experiment presented pairs of old and new words at test and asked subjects to pick the "correct" choice, i.e., an incidental verbal discriminating procedure? Was it the use of lists of items in both cases for acquisition--would access be facilitated in the second case if we used the passage procedures of exp. 1c? Would facilitation occur if the second case had acquisition and test spread across two sessions? Followup work can examine such possibilities. In any event, the fact that it so obviously must work (and does), invites closer examination of what it is that makes it so obvious.

Summary.

At this point we are still in the early stages of investigating spontaneous access using this classification paradigm. Nevertheless, our work to date indicates that this methodology is both generally applicable to a variety of materials and provides a potentially sensitive measure of the occurrence and nature of spontaneous access processes.

Perceptual Identification and Spontaneous Access.

In our search for more precise and general methods for investigating spontaneous access, we conducted a series of experiments using perceptual identification procedures (Jacoby & Dallas, 1981). In this work, people were first presented with lists of acquisition sentences. Later they were presented with words masked by noise and were asked to identify the words. Some of the words were old (i.e., had occurred in acquisition sentences) and some were new. Furthermore, the identification test lists were structured so that old items often succeeded other old items from the same acquisition sentences. This ordering allowed investigation of priming effects due to previously experienced relations among the words. Subjects were not informed about the relation between the acquisition sentences and the subsequent word identification task.

Our hope was twofold: 1) that subjects would show a general enhancement in identification of old items even when not informed (which they did) and, more importantly for our purposes, 2) that subjects would show evidence of "automatic" priming in identification due to previously experienced semantic relations among the words (which they did not). The key here is "automatic". Subjects did indeed show enhanced identification of primed words but the results of a number of manipulations indicated that these effects were the result of "intentional, strategic", rather than "automatic", processes.

The results were interesting in their own right, but we were interested in exploring the effects of such semantic relations on spontaneous access. These results equivocated the potential utility of perceptual identification procedures for this purpose. "Intentional, strategic" use of semantic relations contained in the acquisition materials implies that access to these materials has already occurred. If use of such relations presuppose access, how can the relations "cause" such access. There are potentially complex processing interactions involved here, but in any case the method did not appear to be well suited to our questions and we have not pursued this line of work.

The primary results of the research are reported in Kasserman, Yearwood, & Franks (1987).

Theoretical and Practical Implications.

When we began the present project we believed that the use of spontaneous access paradigms might provide information that is not available through the use of directed access paradigms. This has

certainly proved true. We have continually been surprised by our results and have had to rethink a number of assumptions. Our current thinking about the theoretical and practical implications of our work are provided below.

Failures of Experts to Simulate Novices.

One implication of our work involves the role of intuitions in the design of experiments and of training programs. Consider first the role of intuitions in our own work. As researchers, the present authors have been conducting research and developing theoretical perspectives related to cognition, learning, and memory for many years. Ignoring modesty, we can claim to be relatively sophisticated observers and thinkers in this area. Yet our intuitions based on this experience have been regularly and dramatically wrong in this work on spontaneous access, while at the same time these same intuitions have been quite accurate in directed access and remembering situations. The problem seems to be quite straightforward.

In the design of experiments we use our intuitions to place ourselves in the perspective of the subjects and imagine our responses to the variables of current interest. Of course in all cases we know the potentials for using an acquisition experience to perform a test task--we are the designers of the experiment. In directed access work the subjects are in essence informed about the possible use of acquisition, thus their cognitive state resembles that of the experimenters. This resemblance allows us to intuitively simulate their performance with some accuracy. The problem is that we have trouble simulating the cognitive state of subjects in spontaneous, nondirected access situations. The subjects don't know what information might be useful in solving the transfer task, but we can't help but know the answer to this question--because we designed the experiment. Of course this doesn't mean that we can't continue these investigations, it just means the work will tend to be more empirically and theoretically (and less intuitively) driven than is often the case in cognitive research.

But this point also has practical implications for training. People who design and implement training procedures are in much the same place as us as experimenters. The trainers are experienced in the area of training and as such are relatively sophisticated observers and thinkers in the area. They know the potential relations between acquisition experiences and subsequent transfer situations because they designed the training procedures around these relations. Just as the relation between acquisition and test conditions often seemed obvious to us but totally non-obvious to our subjects, relations that seem obvious to the trainer may be opaque to the trainee. Training conditions that should obviously promote spontaneous access and transfer, may well fail, and furthermore the failure might easily be attributed to other variables like motivation just because the relation is so obvious to the trainers (just as we are sometimes tempted to attribute our subjects' dismal performance to laziness when our confident intuition about a cognitive variable fails.)

There probably is no quick fix for our intuitions as sophisticated experimenters, teachers and trainers--it is doubtful that we can return to "conceptual innocence", to use the delightful phrasing of George Miller (personal communication, 1988). There are two things that can be done. One is simply to be aware of these potential failures of intuition so that we don't misattribute the locus of the problem when spontaneous access and transfer fail. Second, these failures of intuition dramatically underscore the need for research and empirical verification not only at the basic research level but also in more practical training situations. The intuitively obvious utility of relations between acquisition experiences and transfer performance that are implemented in training programs need experimental examination--our expert intuitions are too often wrong when it comes to novice performance.

Directed vs. Spontaneous Access.

A second issue of practical concern brought out by the present work involves the use of extant learning and memory research as guides for the design of training programs. Our findings suggest that many of the variables that are major factors in directed access remembering are not important influences on spontaneous access or nondirected remembering. For example, pictorial (vs. verbal) information, levels of processing manipulations, and elaborative processing variations were all shown to be helpful in directed access performance but to have no effects on spontaneous, nondirected use of the same information. Other variables like categorical structure did influence spontaneous use of acquisition information.

In terms of basic research these results suggest that we begin a systematic investigation of the effects on nondirected access of the many variables that are known to affect directed access. In terms of training they suggest caution in generalizing from directed to nondirected access situations. This is not to argue that variables that don't affect spontaneous access are somehow less important. It is to suggest that the utility of such variables has certain constraints. These variables do influence retrieval of previous experiences but such effects presuppose prior attainment of access. Once access is achieved either spontaneously or through explicit directions, these variables can be important mediators of performance.

In our future research we are going to investigate designs with combinations of variables in which some are expected to influence spontaneous access per se while others show their influence after this access is achieved. This work will further elucidate the different stages of access and use of previous experiences as well as have direct training implications.

The Importance of "Transfer Appropriate Processing".

A third implication of our work is related to the theoretical concept of transfer appropriate processing (Morris et al., 1977; Bransford et al., 1979). This concept places important constraints on the well-known

principle that transfer is facilitated by the similarity in conditions at acquisition and test. Our results suggest that the constraints on similarity are two-fold: first the similarity that is necessary for promoting spontaneous access is often extraordinarily specific. Second, and related to the first point, the similarity and specificity involves more than just similarity "conditions", (i.e., in the information structures) between acquisition and transfer situations.

As suggested by the transfer appropriate processing principle and as supported by the findings in both the insight problem and the classification paradigms, similarity in intentions and actions can be at least as important as similarity in conditions. One can have virtually identical external conditions but no spontaneous access unless intentions and actions are similar and one can have quite discrepant external conditions and get spontaneous access given close similarity in intentions and actions. This is not meant to imply that similarity in conditions is unimportant in the design of training procedures. Rather, it suggests that the typical focus on informational similarity be supplemented by increased attention to the intentions and actions toward these informational complexes that are evoked in the learner by the acquisition and potential transfer situations.

The findings related to interference effects suggest a corollary to the transfer appropriate processing principle and the specificity of its application. If people have inappropriate intentional sets and/or perform inappropriate actions during acquisition, similar future conditions will evoke these same intentions and actions. This will result in interference with corrective training and this interference is resistant to conscious control. The message is straightforward; try to maximize appropriate (minimize inappropriate) intentions and actions during learning.

Roughly, the message seems to be "train people under the same conditions with the same intentions and actions that will hold for the future performance situation". Unfortunately, this would often be very expensive and very difficult, if not impossible. The potential transfer conditions can be both highly complex and varied and each must be associated with the appropriate intention-action structure. Until recently, these circumstances might have been grounds for pessimism regarding the potential for radical improvements in training procedures. Now innovations in computer supported video technology hold the promise of allowing us to design training programs that can efficiently engage trainees in particular intentional actions in the context of a wide variety of quite specific situational conditions. An important area for further research on spontaneous access will involve experimental examination of prototype acquisition and transfer situations using this new technology.

Possible Roles of "Re-cognition" in training

A final implication of our findings involves the important role that repetitions play in promoting spontaneous access. In our studies using the classification task, data across a number of different experiments were very consistent: spontaneous access and use of information was

much more likely to occur if the old items used during the test had been repeated during acquisition. As noted above, the same acts and intentions had to be repeated as well.

What happens when a word is repeated during acquisition? We assume that Ss consciously realize that it has repeated. Thus, their encoding might be "This is a repetition of word presented earlier". Furthermore, this encoding was generated by Ss rather than supplied by the E. Our assumption that repetitions during acquisition are consciously noted is supported by results of a study that was not reported earlier: We tried to ensure that Ss were conscious of repetitions by asking them to explicitly indicate each occasion in which a word was repeated during acquisition. They were excellent at this task and showed the same rate of access and use as Ss who were not asked to write down acquisition repetitions.

Consider what happens when a word that was repeated during acquisition (e.g. leaf) appears at test. Ss should be likely to encode the occurrence of this word as: "This is one of those words that was repeated during acquisition". This encoding should be relatively dominant and conscious (especially since it was self-generated during acquisition) and hence play an important role in Ss' active hypothesis set.

We noted above that the effects of repetitions appeared to operate at the level of events rather than words--access was affected by words-plus-acts rather than words alone. Thus, Ss in the "write at acquisition" condition who encountered "leaf" a second time presumably encoded it as "This is a repetition of the task of writing down the word "Leaf". When a writing task was also present at acquisition, spontaneous access was likely to occur.

The importance of acts seems to have very important implications for training. Intuitively, it is much easier to solve a problem that one has solved before, or to solve one that is very similar to one solved before. However, in many training procedures different examples of problems are given each time rather than periodic repetitions of the same problem at later points in time. the judicious presentation of repetitions may have a very important effect on transfer -- perhaps because it prompts the generation of relevant information by the learner. This possibility has implications that are important to pursue.

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